Contours of death : disease, mortality and the environment in early modern England

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Abstract

Interest in health and the environment dates back many thousands of years and is particularly associated with the Hippocratic works, *On Airs, Waters and Places.* The seventeenth and eighteenth centuries saw a resurgence of Hippocratic ideas. Physicians and topographers began to collect sets of medical and environmental observations and to ask why diseases varied according to locality or season, why certain environments seemed more conducive to ill-health than others, and, in turn, whether such knowledge could be used to intervene, ameliorate, manage or avoid unhealthy sites. This paper seeks to readdress these environmental issues using the tools and techniques of historical demography and a multifactorial approach. Mortality and epidemiological data from a very large number of parishes in Southeast England are analysed, as a way of understanding the influence of 'airs, waters and places' on early modern populations. The paper concludes that features of the natural environment accounted for some of the spatial variations in disease and mortality, but many epidemiological patterns were far more complex, reflecting the significance of a range of environmental, social, economic, biological and demographic variables. In trying to reconstruct past epidemiological landscapes, it is now time to 'move beyond the real wage', to move beyond 'airs, waters and places', and to avoid the temptation to search for any single determinant of mortality patterns and their changes over time and space.

Introduction: airs, waters and places—beyond the real wage

Economic and demographic historians of the early modern period are now familiar with the concept of the 'real wage' and its role as a determinant of population change in the era of the demographic transition (Wrigley and Schofield 1981). From the time of Malthus to the post-McKeown era, scholars have grappled with such variables as wages, income, labour supply and demand, subsistence resources, grain prices and levels of nutrition as determinants of both short- and long- term fluctuations and changes in mortality (Malthus 1986 [1798]; McKeown 1976; Appleby 1978; Wrigley and Schofield 1981; Walter and Schofield, 1989). The papers by Landers and Kunitz and Engerman in this volume discuss the contributions of historians to the real-wage and standard-of-living debate in the context of mortality change. These papers show that findings of recent generations of quantitative historians remain far from conclusive: the usual expectation of a secular relationship between changing real wages and changing mortality was not as Kunitz and Engerman write always realized. It is now time to move 'beyond the real wage'.

To move ‘beyond the real wage’ requires, as Landers (1986, 1987, 1990) has shown in his recent works, that we examine critically the position of mortality both within the domain of historical demography and within the cognate fields of economic and social history. Landers has done much to reassert the role of mortality, to rescue it from the confines of ‘autonomy’ or ‘exogeny’ (Chambers 1972; Lee, 1985) and to look again at the correlates, the flows and linkages between mortality, patterns of disease transmission and economic, social and environmental explanatory variables (Landers 1990). It is not the intention of this paper simply to reiterate these current concerns though the present author shares Landers’s view that mortality deserves renewed recognition. Instead, this paper steps back in time and looks, first, at some of the environmental ideas that have preoccupied a succession of physicians and writers for many hundreds of years before and after the time of Malthus. It then examines how these same preoccupations can now be fitted into a framework of historical epidemiology. It takes as its theme the Hippocratic heritage of ‘airs, waters and places’.

Patients and physicians have for centuries tried to understand the ebb and flow and geographical patternings of epidemic and endemic diseases. The idea that atmospheric and environmental influences might affect patterns of disease and mortality dates back many thousands of years but is particularly associated with the works of Hippocrates in Greece in the fifth century BC (Sargent 1982). The Hippocratic concept of ‘airs, waters and places’ received significant and renewed attention in the seventeenth and eighteenth centuries. Physicians began to ask why diseases varied according to locality or season, why certain environments seemed more conducive to ill-health than others, and, in turn, whether such knowledge could be used to intervene, ameliorate, manage or avoid unhealthy sites (Jordanova 1979; Riley 1987). The lie of the land, the nature of the terrain, the type of soil, the proximity to stagnant, salt or fresh water sources, moderated or tempered by the direction of the wind, the temperature of the air and the quality of the atmosphere all appeared to influence and impinge on the health and well-being of a locality and its residents.

One of the most striking of these environmental images was the notion of ‘bad air’ and its association with marshland topography. Mortality levels in marshland localities were reckoned to be unusually high and residents and visitors complained bitterly about the marsh fevers or agues they encountered in such localities. Many physicians and writers in the early modern period were convinced that it was the noxious stenches that appeared to emanate from the stagnant marsh waters, which were primarily responsible for such hazardous conditions. In Romney Marsh

> the large quantity of stagnating waters ... engenders such noxious and pestilential vapours as spread sickness and frequent death on the inhabitants ... the sickly countenances of them plainly discovering the unwholesome air they breathe in (Hasted 1797-1801 vol. 7:253-254).

and in the Fens ‘awful reservoirs of stagnated water’ were observed ‘which poisons the circumbient air ... and sickens and frequently destroys many of the inhabitants’ (Parkinson 1811:21). The link between marsh fever and stagnant water was, in fact, so clear that anyone could predict with considerable certainty, upon examining a locality, whether or not the residents were subject to that affliction (Forbes 1836:183). Indeed, the stenches, the miasmas and the fevers became such a recognized feature of marshland terrain that it was this miasmic explanation of the marsh fever which gave rise to the word ‘malaria’ or ‘mal’aria’, literally meaning ‘bad air’.

Elsewhere, topographers and physicians searched for further links between disease patterns, bad airs and stagnant waters. Many remained convinced that even beyond the English marshes there was ‘something in the air’. They, accordingly, looked towards terrestrial and atmospheric effluvia emanating from rivers and streams or from stagnant sources of decay, putrefaction and dirt. In urban settings writers shifted their attention away from the natural environment, elements of altitude, soils, terrain, exposure, wind direction, and focused instead on attributes of the man-made environment in conjunction with the conditions of its population. Towns and the confined spaces of the poor and sick were often viewed as places of 'a thousand stinks'. Steams of effluvia and noxious vapours were believed to arise from open sewers, churchyards, slaughter houses, butchers' shops and lanes, dead flesh, burial grounds, cesspools and from every other sort or putrefaction, excrement, decay, human and animal filth. The offensive and 'notorious fountains of stench' corrupted the air, created terror amongst the inhabitants, and made 'the people sick and faint as they pass by' (George 1966 [1925]:349). Putrid exhalations might also arise and be contained in such closed spaces as cellars, garrets, cells, common lodging houses, tenements, courts, alleys, alehouses, ships, prisons, and workhouses. These were the pestilential black-spots, the 'pest-houses of concentrated contagion', the sinister spaces where 'darkness, dirt and stagnant air combine to augment all the evils resulting from such a situation' (George 1966:64, 96). These were the pockets of high mortality.

Fresh airs and running waters were the antithesis to bad airs and stagnant waters. Country airs and sea airs, distant from marshland exhalations, were said to be very healthy, especially

> dry, open situations meanly elevated, neither like beacons on tops of lofty mountains, nor like reeds in the marshy vallies, are above all others (*caeteris paribus*) the healthiest; for such habitations have a free, pure, open air (Short 1973 [1750]:13).

Spring waters and water from fast-flowing streams and rivulets were praised for their purity of taste and smell. In urban settings, social reformers and military doctors began to focus more and more of their attention on the advantages of fresh airs and pure waters. Freely circulating air, the removal of all foul substances, the supply of fresh water in the towns, in the apartments of the poor, in the hulks of the ships, in the prisons and elsewhere became as important an objective as the removal of bad airs from the marshes (Riley 1987).

In order to substantiate their environmental hunches, physicians began to collect and collate a wide range of information on disease and mortality, atmospheric and environmental circumstances, clinical and meteorological observations (Cassedy 1974; Jordanova 1979; Sargent 1982; Riley 1987). With such information, men like Thomas Short remained convinced that they would be able to

> shew the rise, progress, extent, severity or mildness, duration, seasons, and degrees of mortality in sundry places, by endemics and epidemics ... which diseases have their frequentest returns, and what places and soils are most liable to them, or suffer slightest or sharpliest by them (Short 1973:110).

Extensive lists and tables were produced and published; mortality data from the Bills of Mortality and parish registers were compared across cities, countries, regions and villages; histories of epidemic diseases and meteorological fluctuations were compiled; arithmetical calculations, ratios, proportions, life tables, and simple measures of association were introduced in order to measure and understand the geographical and environmental influences affecting human health.

The medical topographies, environmental and epidemic histories produced by these writers contain a wealth of astute and interesting observations. But in trying to make sense of disease causation and the environmental links, many writers became increasingly aware of the complexities of their epidemiological landscapes. 'Airs, waters and places' were not always sufficient to explain and understand the seemingly complex and elusive patterns of epidemic disease. They added to their list of 'airs, waters and places' a whole constellation of geophysical, economic, medical, and social influences. They considered associations concerning both places and people, situations that generated diseases, situations that brought people into contact with a disease, situations which predisposed individuals to the disease (Hamlin 1992:52). A large number of different forces were discussed: meteors and comets, states and prices of the fruits of the earth, cattle distempers, the character and customs of the citizens, diet and alcohol, cleanliness, religion, clothing, modes of employment, housing, crowding and ventilation, trades and manufactures, manner of life, wealth, populousness and circumstances of the inhabitants, local therapies and medical practices, hospitals and quarantine establishments, the role of infection and means of dissemination; any or all of these influences might hold the key to the complex and elusive patterns of epidemic disease.

The role of environmental influences: a framework for historical demography

The data compiled by these writers tell us much about the outline images of the worlds of disease and death that surrounded them while their attempts to gather more and more data, to explore the relationship between mortality patterns and extensive lists of variables serve to remind us of the complexity of epidemiological associations in times and places of disease and death. In spite of their aims and ambitions, in the end they were unable to quantify and unravel the complexity of the relationships. As Thomas Sydenham, the English Hippocrates of the seventeenth century, had been forced to admit:

> much and diligently as I have observed the different characters in respect of the manifest atmospheric changes of different years with a view to detecting therein the reasons for the discrepancy amongst epidemic diseases I confess that I cannot find I have proceeded one single inch on my way (Sydenham 1848-50 vol. 1:33).

Today, as historical demographers, we have infinitely superior tools of computational analysis. We also have a more complete picture of the pathogens, the vectors, the vehicles and human intricacies of disease transmission. In particular, we are aware that different diseases have different modes of transmission. Environmental forces can be important but they are disease-specific. The influences that shape and determine one disease may be quite different from those that control another. We are aware, too, that human response in the face of infection can vary enormously depending on such factors as age, gender, previous exposure, nutritional experience, level of immunity and resistance. And again, these will vary in turn, according to the particular infection. Smallpox, plague, malaria, typhus, typhoid, dysentery, tuberculosis, venereal disease, influenza, infantile diarrhoea and a phlethora of other afflictions of pre-industrial times all had their own distinctive patterns and paths of human interaction and epidemiology. With this knowledge and with the statistical and computing packages now available, can we begin to understand the spatial patterning of the complex array of diseases that afflicted early modern societies: to appreciate why certain localities, environments, seasons, and periods of time seemed to experience a heavy toll of epidemic disease and mortality while some remained relatively free from the frequent onslaughts of plague, smallpox and fevers? Indeed, how far are we able to confirm that the gradients, the contrasts and the fluctuations in health conditions of different localities and seasons, as described by topographers, actually existed in England at this time?

Historical demographers and epidemiologists have made surprisingly little inroad into these spatial and environmental issues. Indeed, the approach of some econometric historians who seek for a unidirectional relationship between one factor, such as temperature or harvest prices, and national or aggregate mortality data, actually runs counter to what we now know about the complexity of local and individual disease patterns and their environmental influences (Lee 1981). In comparison with the outpouring of historical discussion surrounding Malthus and the role of the real wage, recent work in the field of historical demography has done little to substantiate, refute or develop the environmental ideas of seventeenth and eighteenth century medical topographers (Riley 1987).

If we are to move beyond the limitations of the early writers, then we must devise strategies for mapping and explaining disease and mortality patterns which take into account local variations and complexities of past epidemiological landscapes. A large data set, incorporating demographic indices for over 1000 parishes in three counties of Southeast England, mortality data for some 600 parishes extending over a period of 200 years (1600 to 1800), and a wide range of possible demographic and epidemiological influences, has been constructed from seventeenth and eighteenth century sources and analysed using cross-sectional and time-series computer packages. Mortality rates and disease patterns were compared across a diverse array of local environments and over two centuries of time, and a multivariate approach was adopted, which included aspects of the natural as well as the social, economic and human environment of each locality and each season of time; by these means a framework was devised in which to evaluate the influence of a range of variables on the health patterns of early modern populations (Dobson 1980, 1989b, forthcoming).

Bad airs and stagnant waters: the geography of malaria and the role of mosquitoes

The most outstanding epidemiological divide within Southeast England was not between rural and urban communities but along the bounds of marshland and non-marshland terrain. It was here that the natural environmental or ecological features proved to be the critical determinants of the patterning of disease and death. In the area of marshland topography and 'bad airs', the seventeenth and eighteenth century writers had written with remarkable clarity and perception. They had sensed with their noses, they had realized through their experiences and their ill-health that some unique and peculiar quality of the marsh air gave rise to frequent suffering and premature death. The belief that it was the 'mal'aria' of the marshes which caused the high levels of mortality and sickness was not, of course, strictly correct. It was not the 'bad air', *per se*, that contributed to marshland mortality. Rather it was an anopheline mosquito vector, capable of transmitting a parasitic disease to humans, that was the culprit in this mortal landscape. Seventeenth and eighteenth century men, women and children were observing, witnessing and falling victim to the true plasmodium malaria. But they were unaware of the real ecological parameters of this disease.

In reconstructing the demographic and epidemiological landscapes of early modern Southeast England, considerable attention is given to the role of malaria in this setting (Dobson 1982). Mortality indices, based on parish register material for over 600 parishes in Essex, Kent and Sussex, show time and again that death rates in marshland parishes were excessively high compared to other places of early modern England. Average crude death rates lay above 50 per 1000, infant mortality rates exceeded 250 or 300 per 1000, and, for at least two centuries, burials remained in excess of baptisms in many marsh parishes. Seasonal and annual fluctuations in mortality presented a near-perfect match against meteorological controls. Cool wet summers allowed marshland parishioners some respite from their deadly fevers but in the hottest months and years of the seventeenth and eighteenth centuries death rates reached exceptionally unfavourable levels. Only a constant flow of newcomers to these mortal areas, 'lookers' or marshmen in search of high wages, prevented their complete demographic decline.

The study, moreover, shows how sharp the divide was between the high mortality levels of the marshy parishes and the lower rates of adjacent 'uplands' or the favourable levels of non-marshland coastal vicinities. Places beyond the 'noisome smells arising from the salt marshes' were far more healthy and experienced significantly lower mortality levels. Indeed, while once flourishing ports like Rye and Sandwich declined in importance over the seventeenth and eighteenth centuries as silting, stagnant waters and malaria took hold, other coastal locations, free from the marsh vapours, like Brighton, Eastbourne and Margate rose to prominence in the later eighteenth century as fashionable seaside resorts, fulfilling the demands of Georgian society for healthy seabathing and good quality 'airs'. One contour up, one stretch upstream, one mile along the coast, and malaria, with all its mortal implications, ceased to exist.

These boundaries fit in precisely with what we now know about the distribution and ecological habits of the English malaria mosquito vector, *Anopheles atroparvus*. It is exactly in those coastal and estuarine areas of slightly saline stagnant waters that this vector breeds most readily and lives in sufficiently close association with humans to act as an efficient vector of plasmodium malaria. And since the mosquito has a limited flight range it rarely transmitted the parasite beyond the marshes. The biting patterns and flight range of this vector and its climatic requirements are all discussed in more detail elsewhere (Dobson 1980, 1989a, forthcoming) where a variety of evidence from the past and present is pieced together to show, conclusively, that *vivax* malaria was endemic in the coastal marshlands and Fens of England. But, as we now know, it was a bite from a mosquito rather than a breath of 'bad air' that caused the marshland malaria.

Malaria was unique in its geography; it was one of the few major endemic diseases of Southern England that was confined, by its vector, to certain environmental limits. It was also ironically one of the few diseases of this period for which a specific therapy, cinchona bark or quinine, had been introduced and recognized to be effective in controlling the symptoms of marsh fever. Its neat ecological boundaries and striking seasonal and annual fluctuations contrasted markedly with the more widespread and erratic nature of many other diseases and afflictions of early modern England. For most diseases and in other localities certain features of the physical environment, certain aspects of climatic variation, and some attempts to remove sources of 'bad air' played an important but by no means the only role in shaping the paths and rhythms of disease and mortality. Even within the marshes of Southeast England, the history of malaria must be understood alongside a whole set of other social, demographic and economic factors (Dobson, 1980). In trying to explain the far more complex patterns and influences of the past epidemiological landscapes of Southeast England, 'airs, waters and places' filter through to the surface contours but are met by a number of other confounding or complicating variables. In our search for explanations, we can cling, like Short and others, so far to the Hippocratic heritage, but ultimately recognize that there were many diverse influences, a whole range of variable forces and parameters affecting disease and mortality, that in the end transcended the natural bounds of time and place.

Altitude and drainage: water-borne diseases and the role of human pollution

One striking and repeatedly observed characteristic of the Southeast England data was the apparent significance of altitude and natural drainage in determining variations in death rates. Low-lying communities, especially those close to rivers and streams, while not as mortal as coastal and estuarine marshland parishes, nevertheless had consistently higher death rates than 'dry upland' settlements, defined as those situated above three or four hundred feet where there was often an absence or scarcity of surface drainage, and water was obtained from wells or natural springs.

Low-lying riverine parishes had average background mortality rates of the order of 30 to 40 per 1000; infant mortality rates between 150 and 200 per 1000; life expectation at birth in the thirties seasonal mortality peaks in winter or spring with a significant rise in deaths during a cold winter; a second minor peak in autumn becoming more pronounced after a hot, dry summer; and an unstable or irregular annual mortality series (as defined by annual deviations around the mean) with little or no obvious relationship between annual mortality, harvests and prices but displaying fairly frequent epidemics of plague (until 1667), smallpox and autumn ‘fevers’, probably dysentery and typhoid rather than typhus (Dobson 1982, 1989b, c).

The upland scene was, by contrast, quite different and, indeed, it was these areas along the North and South Downs, the chalk hills of Essex and High Weald of Kent and Sussex which appeared outstandingly healthy by comparison with the typical image of early modern England. Individuals lived to ripe old ages and examples of longevity were often cited as evidence of the healthiness of these places: in Little Canfield, wrote one eighteenth century observer,

> the situation we may venture to say is healthy from instances of longevity in some of its inhabitants ... Richard Wyatt arrived to the age of 101 years and upwards ... a predecessor ... died here at the age of 90 ... Thomas Wood was church clerk 78 years and died in May 1738 aged 106. He kept his bed but one day and could see without spectacles to the last (Muilman 1769-72 vol. 3:264).

Our own mortality estimates substantiate these claims. Death rates were generally less than 25 or 20 per 1000; infant mortality rates scarcely rose above 100 per 1000; life expectancies approached 50 or 55 years; seasonal and annual burials deviated less sharply from year to year; there was a notable absence of autumn mortality peaks in High Wealden parishes though occasional summer mortality peaks were experienced in chalk downland parishes after unusually dry summers; major mortality surges resulting from epidemic visitations (rather than famine) occurred in upland areas but they were irregular and, on the whole, less frequent than in other parts of Southeast England (Dobson 1982).

An environmental hypothesis immediately seems to equate with these differential patterns and, as with marshland mal'aria, it is hardly surprising that seventeenth and eighteenth century topographers again believed that the quality of the airs and the waters had something to do with these contrasting situations. While they imagined morbific particles suspended in the atmosphere or deadly vapours emanating from telluric effluvia and sluggish waters, we can now look back and implicate a range of bacterial and viral organisms, which might be identified with diseases such as typhoid, paratyphoid, dysentery, viral meningitis and other gastro-enteric or water-borne 'fevers' (Dobson 1982, 1989b). Rivers and streams at low discharge, as well as stagnant marshes, may well have provided the ideal conditions for trapping such organisms and, in spite of our limited knowledge of the insanitary behaviour of early modern societies, given what we know of their habit of throwing 'divers unhealthy bodies called in English "blude, garbage and guttes"' (Dobson 1982:286) into local water courses, it is quite likely that villagers and townsfolk adjacent to such sites invariably suffered 'from a want of a sufficient supply of good water ... when the river is nearly stagnant and always unfit to drink' (Dobson 1982:287).

Just as some writers, especially from the mid-eighteenth century onwards, began to recognize and emphasize the role of human excrement, filth and decay as additional causes of 'bad air', so we can confirm that it may well have been human pollution and contamination, rather than some mysterious telluric or atmospheric effluvia, that contributed to the unhealthy nature of many riverine localities, and probably added a further pathogenic load on the already mortal marshlands. Proximity to water courses, fouled by human contact, led to the invasion of all sorts of morbid and potentially fatal water-borne pathogens, and seventeenth and eighteenth century accounts of 'autumnal fevers' in these low-lying districts (their symptoms, their seasonality, and their epidemiology) point to an unusually high prevalence of water-borne diseases (Dobson 1982). Access to natural spring or well water, by contrast, may have provided a supply of relatively pure drinking water and it is pertinent that it was during the driest summers, when the water table on the chalk downlands was low and people were 'forced to go from door to door to beg a pail of water' or carry water from the lowlands to the high chalk parishes 'for the barest necessities of life' (Dobson 1982:305), that summer mortality levels, in these otherwise healthy locations, peaked sharply (Dobson 1982). The environmental association moves from 'good and bad airs' to 'good and bad waters'. But it also moves along the chain from simple ecological cause and effect (marsh mal'aria equals mosquitoes equals malaria) to one which begins to take into account elements of human behaviour and the quality of the 'human' environment.

Urban environments and pastoral settings: the role of human behaviour and population movements

Contaminated water supplies and water-borne diseases, particularly following hot summers, appear to have played a significant role in the epidemiological regime of early modern populations, long before they rose to prominence in the cholera era of the nineteenth century. But further epidemiological evidence indicates visitations of all sorts of other diseases, implicating factors beyond 'bad waters'. Plague, smallpox, typhus, venereal disease, influenza, measles, scarlet fever, diptheria, bronchitis, pulmonary tuberculosis, botulism, salmonella and food poisonings, brucellosis, bovine tuberculosis, trichinosis, worms, and various occupational hazards, were just some of the other afflictions that stand out on the epidemiological map of early modern Southeast England. We can assume that the chain of disease causation was entered by many sources of contamination, besides water, such as food, milk, faeces, manure, dust; diverse noxious substances, including alcohol, opium, lead and chemical pollutants; and different mechanisms of disease transmission, such as rodents, livestock, flies, fleas, lice, and person-to-person contact. A broader environmental framework could, thus, be extended to explain and include disease pathways associated with all sorts of insanitary conditions, all range of foul habitats and habits, and any number of hazardous practices and crowded occasions that would have brought together humans and their disease pathogens to make certain localities or seasons more unhealthy than others.

Within the marshland-non-marshland and riverine-lowland-upland divides, there were, indeed, further local variations in mortality levels which, on the surface, would suggest that crowded and filthy conditions were likely to produce higher levels of mortality and more varied patterns of disease. The rural-urban divide is an obvious one and while many historians have tended to present the situation, outside London, as a dichotomy (provincial towns were unhealthy, countryside was healthy) the Southeast England data, which include information for about 50 urban places, suggest that within the provincial urban hierarchy there were significant differences between towns which were not simply related to size and population numbers, but more critically associated with function, location, population movements, and the type and conditions of the urban environment. The rapidly expanding ports and docklands of Kent, for example, experienced higher mortality rates and a far more erratic pattern of epidemic mortality than many inland market towns or the cathedral city of Canterbury, while even quite small towns close to London showed a distinct disadvantage over larger but more distant towns.

The Thames and Medway ports were particularly unhealthy right through the seventeenth, and eighteenth centuries and well into the nineteenth. They maintained their excesses of burials over baptisms, their high levels of mortality, and striking autumnal seasonal peaks, at a time when other towns were witnessing reductions in death rates. In the early decades of the nineteenth century, burials still exceeded baptisms in some of these ports, infant mortality rates remained above 250 per 1000 and life expectancies were in the low thirties at a time when some towns in Southeast England were experiencing a life expectancy above 40 years (Dobson 1982, forthcoming). Adjacent to the low-lying estuarine marshes the ports were, like smaller parishes along the north shore of Kent, undoubtedly subject to 'bad airs' and 'bad waters'. Malaria and a range of water-borne infections were especially prevalent in these localities. Alcohol and opium were consumed in excessive quantities as a way of coping with the constant invasion of fevers. But contemporary accounts indicate that these were only part of a whole complex set of endemic and epidemic diseases. Southall, as early as 1730, made an interesting observation concerning bedbugs and dirt. He noted that 'not one sea-port in England is free, whereas in inland towns, bugges are hardly known' (Southall 1730). The epidemiological evidence suggests that typhus, a disease transmitted by body lice, was highly concentrated in the congested areas of the Thames ports, the docklands and suburban London while almost unknown in other parts of Kent. Plague epidemics in the seventeenth century also showed a striking preference for the ports and outlying areas of London. Massive epidemics of plague occurred in places like Greenwich, Chatham, Sittingbourne, Gravesend, Rochester, Woolwich and Deptford. Air-borne infections, especially epidemics of smallpox, also struck these types of urban environment with particular force, frequency and intensity. Pulmonary tuberculosis was another disease concentrated in areas of crowded living and working quarters and it is likely that a considerable proportion of the winter or spring rise in mortality, especially during severe winters, was attributable to this and other respiratory causes of death in the densely populated neighbourhoods of ports and towns close to the metropolis. Indeed, the spread of many infectious diseases, scarlet fever, diptheria, measles, pneumonia and others, would have progressed rapidly in urban areas where human interaction reached its most intimate.

When we turn to contemporary descriptions of the squalor, the filth, and the overcrowding, especially along the dockland areas of north Kent, by comparison with the more spacious and salubrious settings of some country towns, it is not difficult to imagine why they harboured and propagated the appropriate vectors, conditions and pathogens for major outbreaks of disease. Moreover, alongside their unfavourable, crowded and insanitary environments they were more frequented, more accessible by road and water, and populated by a greater mix of peoples than many inland communities. People lived, worked and interacted in close proximity with each other; they came into frequent contact with travellers and visitors from London and from overseas; they attracted throughout the seventeenth and eighteenth centuries a constant influx of new occupants and young migrants, merchants, sailors, traders and buyers; they housed a complex mix of poor and rich, young and old, temporary and permanent residents; they generated pockets of squalor and set up institutions for the diseased, the criminal and the poor; they became noted for their shifting maritime populations and notorious for attracting some of the more destitute members of Kentish society: rough seafaring men, oyster dredgers, smugglers and alehouse keepers, all of whom left their mark on the mortality statistics. They provided the ideal conditions for mixing population groups with different prior experience of disease: foreigners and residents; immunes and non-immunes; the contagious, the sick and the healthy; carriers and potential victims.

These ports were also in a prime location to receive not only people, goods, and merchandise from a range of origins but also a plethora of old and new infections, their hosts and vectors, from places like the West Indies, the Americas, Africa and Europe. This was a zone where people and pathogens constantly interacted, where travellers, immigrants and residents were caught up in the ‘unification microbienne du monde’ (Le Roy Ladurie 1978) as global exchanges of disease followed the channels and routes of overseas trade. The ebb and flow of population movements, with all their concomitant complexities and ramifications, added an indeterminate but highly relevant role to the paths and patterns of disease and mortality.

Within the rural areas of lowland and upland Southeast England other more subtle but perhaps equally significant contrasts are manifest in the mortality statistics, contrasts which again suggest that gradients of disease and death were moulded by local characteristics and also affected by wider population movements. One such example existed between pasture and arable farming areas. Mortality levels in parishes with large herds of livestock tended to be slightly higher than those based on grain or market gardening. There was also a greater prevalence of autumnal fevers, especially during the later seventeenth and early eighteenth centuries (Dobson 1989b). All sorts of possible influences may have accounted for these patterns, some of which we can measure, others we can only infer. It would be interesting to know, for example, whether factors such as diet varied locally. Did market gardening areas benefit from the availability of fresh fruit and vegetables? Were pastoral communities more likely to suffer from the harmful effects of contaminated meat and milk? We need more information on rural habits of sanitation and the disposal of human and animal excrement. Did some villages heed contemporary advice and keep all foul substances at a distance from their cottages? Were there differences in the arrangement and type of domestic and animal living quarters which influenced health in arable and pasture areas? If we are to extend the link between filth, crowding and population movements then we could speculate that proximity to animals, their dung, rodents, flies and other disease-carrying vectors, and the crowded domestic living conditions of dairy farms, were important epidemiological controls. In many pastoral areas, farmers in the later seventeenth century were encouraging agricultural servants to live in for a year or so rather than pay them a daily wage and, at the same time, the farmers of southeast England were increasing their herds of livestock as the price of grains started to fall. Kussmaul (1981) has described the shared sleeping and eating arrangements of servants and masters, and cites seventeenth-century references to chambers over oxhouses and servants' beds in stables. The effect of very close human and animal contact on the level of mortality may have been significant. Moreover, many of the living-in servants were hired and arrived in their new household during the autumn at a time when, especially following hot dry summers, certain pathogens and their vectors were most active. It is possible that some of these young people were moving into new types of environment and encountering new sets of diseases for which they had little prior experience, resistance or immunity. The combination of seasonal population movements and the mixing of humans, animals and disease agents in certain localities and at particular points in time may have contributed to the elevated mortality and autumn fever peaks of lowland pasture parishes.

Healthy airs and upland communities: the role of local influences and patterns of outward migration

At the opposite end of the mortality spectrum, we need to look for factors that explain the unusually favourable background, seasonal and annual mortality patterns of many upland localities. Historians traditionally enjoy focusing on the darker sides of life, the blacker pockets of human mortality, but a striking feature of this regional survey is the remarkable persistence of much lower levels of disease and death across wide areas of upland Kent, Sussex and Essex for many decades over the seventeenth and eighteenth centuries. In an era of poor and inadequate sanitation, filthy living conditions, almost non-existent medical care, low standards of nutrition, how was it possible for some communities to achieve infant mortality rates below 100 per 1000 and life expectancies as high as 50 years in the early modern period? Were there specific environmental or local features that acted as protective mechanisms, or were these places sufficiently isolated from the main flows of population to avoid some of the worst visitations of disease and death?

Eighteenth-century topographers emphasized repeatedly the exceptionally healthy air of upland parishes. These parishes were certainly well elevated and far enough away from the marshes to avoid the 'bad airs' of malaria, and, as has already been suggested, the absence of surface drainage, or 'bad waters', along the dry chalk hills may have to some extent protected them from the seasonal impact of water-borne diseases. In downland areas, arable farming and extensive sheep grazing were more important than dairying and cattle-rearing, and lesser levels of contact between animals and humans, lower densities of flies and insects and fewer sources of manure and cattle dung may have reduced the transmission of certain parasitic, bacterial or viral infections. The ready availability of local fuel supplies, in the form of timber and charcoal, may have acted as an additional protective mechanism in some upland communities and it is interesting to note that exceptionally cold winters did not produce an upsurge in mortality in the heavily wooded Wealden areas as they did in some other parts of the country. The distribution of settlements within these areas may have been less conducive to the spread of infections than in other types of locality. Population densities along the Downs were low, there were no towns, few manufacturing industries, and little evidence of overcrowding. The High Wealden parishes covered much larger areas but within their sprawling bounds the settlements, hamlets and farmsteads were scattered over relatively wide distances. Few institutions were set up to house the diseased or the destitute in these parts and interactions between the sick and the healthy may have been kept at much lower levels than in more densely populated lowland areas.

The list of possible local influences could be extended. However, when we turn to some of the material conditions and characteristics of the inhabitants and their habitations, there is a startling inverse relationship between levels of wealth and health. These upland communities were not only areas of exceptional health but also regions of depressing or acute poverty. For the North and South Downs, the poverty was reflected in the infertile soils, the unproductive farming economy, the drab and dreary appearance of the countryside, the poor stoney and narrow state of the roads, the mean and shabby condition of the houses. Cottages were made of local flints and wood and thought old-fashioned, and the peasants themselves were described as equally rough and uncultured as the soil they tilled. In the High Weald, poverty resulted from a different set of circumstances. Population pressure and an economic dependence on a formerly profitable but declining textile industry combined to present tremendous difficulties for communities in these districts by the seventeenth century. Frequent expressions of hardship were heard at this time when the declining cloth trade of the Weald gave rise to ‘the loud and heart piercing cries of the poor ... and the disability of the better sort to relieve them through the total decay and subversion of the trade’ (Dobson 1989b:409).

Levels of poverty, as indicated by the proportion of exempt householders in the 1670s Hearth Tax returns, were depressingly high with some two-thirds of textile parishes classifying at least 45 per cent of their householders as non-chargeable. A century and a half later those same parishes continued to exhibit marked signs of economic malaise and poverty and, throughout the period, observers commented on the mean state of the cottages, the appalling condition of the clay soils and roads, parched in summer and deep muddy tracks in winter, and the impenetrable backward nature of the countryside where the tenantry were

> as poor, weak and spiritless, as their lands, drawn down, as for ages they have been, with exhausting crops without a sufficiency of stock, or of extraneous manures, to make up for this endless exhaustion (Marshall 1798 vol. 2:133).

We do not, as yet, have detailed local evidence on standards of living, food supply, diet, clothing, sleeping arrangements, habits of cleanliness, ways of dealing with human excrement, patterns of breast feeding, infant care, or welfare of the elderly in these contrasting regions but if we are to assume that these poverty-striken communities could not afford as many basic provisions and necessities as their contemporaries then such inadequacies were not apparent in the mortality statistics of upland communities. Pockets of poverty appear to have matched pockets of disease in many urban environments, especially by the nineteenth century (Woods and Woodward 1984; Slack 1985; Landers 1990), but within the rural sphere in the early modern period, the ‘real wage’ does not seem to have influenced mortality gradients. Indeed, the epidemiological consequences of this type of poverty worked in their favour. The very fact that these regions were poor, backward, impenetrable, relatively isolated and inaccessible gave them a distinct advantage over their more frequented and busy lowland counterparts. For the 200 years of this study both the Downs and the High Weald were areas of substantial outmigration. Labourers and young people moved away from these unproductive localities in steady streams to seek better fortunes in places like London, Europe and the New World (Dobson 1989b, c). They left behind an aging population and this in itself may have accounted for the instances of longevity in these parts. But they also left behind villagers whose daily, seasonal and annual rhythms of work brought them into less frequent contact with the mixing and movements of microbes.

Indeed, it is an irony of the migrational patterns of this region that the areas of Southeast England which attracted the greatest numbers of new migrants were those that already had the least favourable environmental living conditions (the marshlands, the low-lying riverine settlements, the ports and towns) whereas the healthy but less prosperous upland environments (the Downs and Weald) were the areas shedding their populations in this period. As more and more people moved to the mortal zones, so the exchange, mixing and susceptibility to micro-organisms were constantly intensified, deepening the pools of disease and death. As fewer people entered or returned to the healthy localities, so those who stayed behind, lived or were born in these parishes enjoyed a relative freedom from the continuous invasion of old and new infections.

A chronology of epidemics: the role of complicating variables

One other perspective of this geographical survey focuses on the timing and spread of those epidemics which crossed the usual gradients of health and mortality. We have already moved from malaria, a disease bounded by natural or ecological features, to the dynamic complexities of other major diseases of the period: their local preferences and patternings, their environmental influences and their associations with the shifting behaviour and movements of early modern populations. But beyond these striking gradients of disease and death, were other more elusive patterns. Some epidemics came and went with seeming irregularity. Outbreaks of smallpox, plague, and spotted fevers, while far more prevalent in certain communities than in others, could also, from time to time, be carved haphazardly or randomly into the topographical landscapes or urban-rural hierarchies. Some healthy spots could be visited while the traditional black spots might avoid the epidemic. ‘New’ diseases could affect isolated, inland localities while leaving ports and busy thoroughfares unscathed. Seasons of scarcity could lead to famine and starvation in some places but not in others. Wet and cool summers could prove healthful to marshland environments but dangerous to others. It was the elusive patterning of some of the epidemic visitations across the divides of airs and waters, across the seasons of want and plenty, which continued to puzzle and frustrate the topographers in their search for simple environmental causal associations.

A reconstruction of the geographical, seasonal and annual pattern of epidemic disease, using the descriptions left by seventeenth and eighteenth-century writers and matched against the Southeast England mortality statistics, shows that the main impact and movement of epidemic disease fitted the contours of lowland, marshland, upland, and the contrasting gradients of town and countryside, already outlined (Dobson 1987). But it also highlights the contrary nature of some of the epidemics of this period; epidemics that appeared to have moved against the usual contours and gradients of space and time. The last part of this paper looks not at the familiar trajectories of plague, smallpox and fevers—the chronology of epidemic disease as well as the following quotations are presented and cited elsewhere (Dobson 1987)—but at some of the contradictions and perplexities of the epidemiological landscape that finally take us beyond the traditional bounds of ‘airs, waters and places’.

The year 1638 stands out as the time of the very worst mortality crisis on the Southeast England chronology of disease and death. John Graunt, the seventeenth-century pioneer of epidemiology, also found that this was the most ‘mortal’ year in his Hampshire parish between 1570 and 1660. The exact nature of the epidemic remains puzzling: it was a ‘malignant fever ... which raged so fiercely about harvest that there appeared scarce hands enough to take in the corn’. It was widespread in the sparsely populated agricultural regions of Kent and Sussex and, ironically, it was in Wadhurst in the Weald of Sussex that it was reported: ‘this yeare was an infectious summer, so that verie many died in many places here in Sussex also speciallie on the Downs’. Another exceptionally sickly time for Southeast

England was the fever years of 1657 and 1658. Many were ill 'in their brain and nervous stock', all complained of their head being 'grievously distempered', in some 'little broad and red spots' appeared and then disappeared, followed by 'a benummedness of the senses and a sleepiness'. Again, it was the geographical peculiarity of this 'new' fever which struck observers, such that by August 1657

> it began to spread far and near, among the people, that in every region and village many were sick of it, but it was much more frequent in the country, and smaller villages than in cities or towns.

At the other end of our period, the years 1779–1780–1781 mark the final major regional mortality peak of the two centuries. The epidemic ague, the 'new' ague or the 'plague ague', as it was called in Kent, was a prolonged, widespread and peculiarly protean fever epidemic. The epidemic was said to harass the upland villages more than communities in adjacent valleys and to afflict all male labourers in the fields, while leaving women nearly exempt. In the downland areas of east Sussex, almost one half of the parishes experienced a rise in burial levels. Deaths in the little village of Patcham, Sussex trebled and a note in the parish register recalls: 'this year was remarkable for a violent distemper which carried off the person afflicted in the space of five days ...'. Places which might normally expect to enjoy low levels of mortality and long life expectancies could still be suddenly and tragically hit by epidemic disease.

Epidemics of influenza were widespread; they visited places simultaneously, regardless of topography, terrain or economy. This was an infection which could invade large areas in a dramatically short space of time. In the spring of 1658 influenza was universal and prevalent in many parts of the world, such that one reporter believed that 'a third of mankind, almost should be distempered with the same in the space of a month'. Indeed, so suddenly did this distemper arise that it was 'as if sent by some blast of the stars, which laid hold on very many together, that in some towns, in the space of a week above a thousand fell sick together'. The influenza epidemic of the winter of 1732-33, likewise, was later described as 'the most universal disease on record'. It visited every country in Europe and raged in America and the Caribbean: 'the uniformity of the symptoms of the disease in every place was most remarkable'. With such a striking global epidemiology, it is not surprising that observers looked beyond atmospheric vapours or person-to-person contagion to some ethereal or extraterrestrial influence, to comets and meteors, a theory that even today finds favour with some scholars (Hoyle and Wickramasinghe 1979).

Plague epidemics showed a striking preference for large urban centres (Slack 1985), but isolated outbreaks, sometimes of severe intensity, were recorded in a number of country parishes during the seventeenth century. A church memorial in the tiny downland Sussex parish of Pyecombe commemorates its alarming visitation in 1603 when 15 per cent of the population died. In some places, plague was simply confined to a few households. The tragic story of the Gale family of the small hamlet of Kemsing in 1636-37, as related by a sole survivor some years later, shows how plague could afflict a whole family but spread no further through the settlement. On this occasion, several women 'laid forth' the dead, 'no manner of clothes were taken out of the chamber', 'a great many people visited the house', and yet 'all this while no one took the distemper of or from us'. In other localities, measures would be taken 'to use the best meanes we can, both to God, and by all outward instrumentall meanes as shall be fittinge' to avoid a visitation of plague; some communities took serious quarantine action by segregating houses, burning contents, removing occupants to a pest house and restricting population movements and, yet, these parishes would subsequently be affected by the plague. Bubonic plague was nearly always associated with hot summers in England, but in the southeast one of the most severe visitations of plague occurred during 1625-26, a time of 'unseasonably' cold, wet springs and summers.

Again, it is ironic that the final outbreak of plague in seventeenth century Southeast England occurred in the healthy High Weald in the community of Biddenden where in June 1667 ‘12 were buried at Betnams Wood of the plague’ and ‘12 more had plague sores which recovered’. The distribution and fluctuations of plague in seventeenth century Southeast England displayed a random quality which added terror to its frightening and unexpected impact.

Other diseases could appear ‘to reign everywhere spread far and wide take hold of whole households’, and yet make little inroad into the mortality statistics. Meteorological signs might presage some imminent disaster: predictions, based on past experience, that ‘our beautiful kingdom will ingender more strange and incurable diseases and infecte the whole nation’, but the ensuing season could remain free from any major onslaught. At other times epidemics would arrive ‘suddenly, unlooked for and unawares’ cutting off the unsuspecting. Some would ‘creep from house to house, infecting with the same evil most of the same family’. Smallpox epidemics could be ‘confluent of the worst kind’, ‘never in the memory of man so fatal’ and, on other occasions, be ‘mild and seldom fatal’. Short noted that ‘there is no general constitution of weather wherein the smallpox are not epidemic somewhere’. Some epidemics would be fatal to ‘the aged, the weak, the consumptive, the gross bodied, the infirm’ or those ‘afflicted with or lately recovered from intermittents’, others would affect those ‘familiarly conversing with the sick’, some would decimate those ‘in their prime of life’ or rage ‘mostly among children and youths’. Even marsh fever was selective in its attack: ‘it is far from being mortal to natives but to strangers and to persons accustomed to a pure air it proves particularly severe, and sometimes fatal’ while, similarly ‘in persons of an ill habit of body it often proves very dangerous’. Epidemics could run their course in a matter of weeks or months or linger for several years. The ebb and flow of epidemic diseases, their waxing and waning over time and space, produced patterns which went beyond natural or environmental boundaries, fluctuations that did not fit any neat meteorological associations, vicissitudes that proved unexpected and unexplained.

The chronology of epidemic disease and mortality for Southeast England highlights the range and variability of the many disorders that afflicted the early modern world. In the epidemiological landscapes of Southeast England, few diseases beyond malaria were entirely confined to specific localities and few people were entirely isolated by geography from epidemic visitations. The role of population movements and their simultaneous passage of vectors, pathogens, carriers and victims, explains many of the dynamic and elusive patterns of infectious disease outbreaks. We cannot track or quantify with any precision the intricate and diverse paths of all these interactions. But even for those who eked out their lives in the more isolated reaches of Southeast England there must have been a certain amount of coming and going: trading, conversing, or socializing with people from other parts of the countryside. Theirs was a world which was apart but never entirely cut off from the epidemiological linkages and flows of the early modern world.

Below the surface channels of local, seasonal and annual migratory movements, other aspects of human populations and their diseases added to the final complexity of epidemiological events. We can, thus, draw on our knowledge of the peculiarities, the distinctive patterns and different modes of tranmission of individual diseases; we can raise questions about the movements of disease vectors, or changing virulence of infections over time; we can address such issues as biological defences, immunity levels, genetic predisposition, age and gender differences, varying responses in accordance with nutritional status, encounters with previous or concurrent infections; we can look at the effectiveness of measures to avoid, contain, cure or quarantine diseased individuals and localities in past times. All of these factors must have played important and complicating roles in the passage and paths of human disease and mortality (Slack 1985; Landers 1990; Hope-Simpson 1992). Whether we are dealing with diseases with strong environmental associations, like malaria (and cholera in the nineteenth century) or epidemics, such as smallpox, which had a less striking seasonal and spatial patterning, the final outcome, the recreation of the epidemiological maps and chronologies of the past, must inevitably reflect the intricate and complex nature of human disease.

Conclusion: from medical confusions to epidemiological complexities

While seventeenth and eighteenth-century physicians searched for associations with 'airs, waters and places' or extended their lists to explore a whole range of environmental, social, economic and epidemiological circumstances and events, they also included in their range of possible influences such attributes as the 'constitution', the 'pre-disposition' or 'peculiar nature' of individuals, the relative 'contagiousness' of different diseases, the 'benefit' or 'danger' of certain treatments. Today, historical epidemiologists can refine or reinterpret these ideas and speculate, for each individual epidemic, the likely interplay of the many different variables, concerning both places and peoples, which might have accounted for the varied and diverse patterns of epidemic diseases in the past. In formulating our ideas and explanations, we can move beyond our predecessors to imagine a world where microbes, vectors and agents of disease transmission, population movements and behaviour, age and sex structures, human biology, maternal and infant care, individual circumstances and environmental conditions interlocked and interacted in all sorts of complex ways (Landers 1990). We cannot always account for individual idiosyncracies in the outcome of disease, but we can explore such questions as the role of immunity, nutritional status, multiple infections and infant feeding practices on the patterns of health and sickness of past populations. We can emphasize complexity where early writers saw confusion.

In extending the field of historical epidemiology, there are all sorts of questions, patterns and findings which still remain to be understood. A broad multivariate approach, which takes into account local variations, seasonal fluctuations, epidemiological subtleties, and human variablity will prove more revealing, even if more taxing, than analyses of aggregate series or simple bivariate statistical correlations. This present study has already illustrated the ease with which certain patterns can be explained and the difficulties of explaining others. Many puzzles will remain and many influences will defy precise quantitative measurement. In a sequel to this paper, secular trends in mortality across different parts of Southeast England will be explored in a way that, once more, highlights and contrasts the apparent simplicity of avoiding or removing 'bad airs' and 'bad waters' in 'places' like the English marshes with the far more enigmatic role of other environmental strategies devised to 'teach men to choose their dwellings for their better health'. In each of these dimensions, it is now time to 'move beyond the real wage', even to move beyond 'airs, waters and places', to avoid the temptation to search for any one single determinant of mortality patterns and changes over time, as McKeown and other scholars have done, and to explore, instead, a whole set of environmental, social, economic, biological and demographic changes: that complex and confusing constellation of associations that absorbed but perplexed the early modern physicians and medical topographers.

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